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Neuroticism and Affective Priming: Evidence for a Neuroticism-Linked Negative Schema

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Abstract

Neuroticism has been hypothesized to systematically relate to semantic memory networks favoring negative affect, but no studies using affective priming tasks have established this link. The present two studies, involving 145 undergraduate participants, sought to provide initial evidence along these lines. Study 1 used a task in which participants were asked to judge their emotions in the past, whereas Study 2 used a perceptual identification task in which participants merely had to identify the word in question. In both studies, neuroticism was positively correlated with negative affective priming, but not positive affective priming. The studies suggest that neuroticism systematically relates to the inter-connectivity of negative affect with semantic memory systems, whether involving the self-concept (Study 1) or not (Study 2). These results are novel and important in understanding individual differences in neuroticism and their affective processing correlates.

Keywords

Neuroticism; Negative Affect; Priming; Cognition; Semantic Memory

Neuroticism is frequently linked to negative affect, worry, and reports of somatic symptoms (Watson, 2000). It is therefore sensible to propose that many of the correlates of neuroticism may involve negatively biased affective memory networks (Rusting, 1998). Although sources of data linking neuroticism to negative judgment and interpretation biases are robust, such data tend to involve self-reports rather than associative measures suited to assessing cognitive-affective processes (Robinson & Neighbors, 2006). Studies that have used cognitive paradigms sensitive to accessibility, interference, and retrieval effects for negative stimuli provide much weaker and mixed support for the idea that neuroticism systematically relates to cognitive biases related to negative stimuli (Matthews & Gilliland, 1999; Rusting, 1998). Thus, it is important to clarify the information-processing basis of neuroticism, which we do here in terms of accessibility effects involving negative stimuli.

On the one hand, neuroticism may predict the speed with which negative affective stimuli can be encoded. However, this hypothesis does not fare well in studies that have examined it (Rusting, 1998; Tamir & Robinson, 2004). On the other hand, neuroticism may relate to affective memory networks favoring negative thoughts. In the latter case, individuals high in neuroticism should exhibit a greater degree of facilitation for the second of two consecutive

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negative stimuli. Indeed, the idea that individuals high in neuroticism have a stronger inter-connectivity of negative affective thoughts seems quite plausible. Individuals high in neuroticism react to negative events more strongly (e.g., Gross, Sutton, & Ketelaar, 1998) and also ruminate on negative events to a greater extent (e.g., Muris, Roelofs, Rassin, Franken, & Mayer, 2005). These sorts of effects appear to implicate spreading activation processes, favoring negative affect, at high levels of neuroticism.

To examine this potential association between neuroticism and negative affective priming, we built upon recent developments in the literature. Affective priming tasks are ones in which the researcher seeks to examine whether exposure to a positive or negative affective prime facilitates (i.e., speeds) classifications of a subsequent positive or negative affective target (Klauer & Musch, 2003). Much of the emphasis in the literature has been on the minimal conditions necessary for affective priming (Fazio, 2001; Klauer & Musch, 2003), but multiple investigators have pointed to the intriguing potential of the task for assessing individual differences in affective memory networks (Banse, 2003; Robinson, in press).

To examine individual differences in affective memory networks, it is desirable to focus on valence-specific priming effects, which permit one to make unique conclusions in relation to positive and negative affective associations (Robinson, in press). Prior studies in this assessment-related tradition link life satisfaction (Robinson & Kirkeby, 2005) and self-deception (Robinson & Goetz, submitted) to stronger priming effects in relation to positive targets, but no research that we know of has linked neuroticism to stronger priming effects in relation to negative targets. This was the specific focus of the present studies. Prior to discussing the specific studies, it is useful to say more about priming procedures.

Priming Procedures

In the traditional priming task reviewed by Neely (1991), primes are presented as task-irrelevant stimuli and it is thought that they will automatically activate an associated semantic memory network. However, this assumption is problematic because people are often quite capable of ignoring task-irrelevant stimuli if not required to encode them (Besner, 2001). Thus, the traditional priming task can be problematic because one can never be sure that the primes activate semantic memory networks (Joordens & Becker, 1997).

This problem led cognitive researchers to develop an alternative priming task, one in which encoding is ensured because individuals must encode both primes and targets (Shelton & Martin, 1992). This “continuous priming” task is thought to be more sensitive to spreading activation processes among related concepts (Joordens & Becker, 1997). Research has also established that the traditional prime-to-target delay of 300 ms (Neely, 1991) appears functionally equivalent to the response-stimulus interval (RSI) in continuous priming tasks (e.g., de Mornay Davies, 1998). Because the present RSI was 300 ms in both studies, our effects should be viewed as automatic according to this more recent literature (de Mornay Davies, 1998; McRae & Boisvert, 1998).

Study 1

Study 1 used an emotion judgment task in which participants were asked to determine the extent to which they experience particular positive (e.g., *joy*) and negative (e.g., *sadness*) emotions in general. Because positive and negative stimuli were randomly assigned to trials, positive and negative targets were equally likely to follow positive or negative primes, defined in terms of the valence of the emotion term on the previous trial (Robinson & Compton, in press). To examine valence-specific associations, priming effects were computed separately for positive and negative targets. We predicted that individuals higher in neuroticism would

be faster with two negative stimuli in a consecutive sequence, a pattern of priming that would suggest a greater degree of inter-connectivity of negative emotional knowledge concerning the self.

Method

Participants

Participants were 55 (34 female) undergraduates from North Dakota State University seeking extra credit.

Measures

Neuroticism—Neuroticism was measured by Goldberg's (1999) broad-bandwidth scale. Participants indicated the extent (1 = very inaccurate; 5 = very accurate) to which they agreed that statements indicative of low (e.g., *am relaxed most of the time*) and high (e.g., *worry about things*) levels of neuroticism generally characterize the self. Goldberg (1999) reports that this scale of neuroticism correlates at $r = .82$ with the well-validated neuroticism scale of the NEO (Costa & McCrae, 1992) and additionally predicts outcomes theoretically related to neuroticism (Goldberg, in press). In the present study, alpha was .87.

Emotion Judgment Task—Robinson and Clore (2002) created an emotion judgment task to examine the sources of knowledge that people draw upon in making self-reports of emotion. A modified version of this task was used in Study 1. Individuals were asked to decide how intensely they generally experience 30 positive feelings (e.g., *excited*, *loving*) and 30 negative feelings (e.g., *angry*, *sad*). To obtain a more adequate database for examining priming effects, each feeling term was shown twice, for a total of 120 trials. Each trial involved a randomly selected stimulus.

To dissociate judgment time from time to make the rating, the paradigm used the procedures of Robinson and Clore (2002). Each trial involved the presentation of a specific feeling term, which was presented in the center of the computer screen. Participants were instructed to decide the extent to which they generally experience the feeling in question, and then to press the spacebar when they were ready to make their rating. In order to preclude spacebar responses prior to deciding upon a rating, the spacebar response removed the feeling term from the screen. During the blank rating screen, participants made a rating by using the 1 (none of this emotion) to 5 (an extreme amount of this emotion) numeric keys at the top of the keyboard. A 300 ms blank screen followed each rating until the next stimulus.

We were interested in judgment times but not rating times, which are confounded by motoric factors. Indeed, previous studies have shown that judgment times are slow, rating times are fast, and only judgment times are psychologically informative (Robinson & Clore, 2002; Robinson & Kirkeby, 2005). The same conclusion applies here. Rating times, despite being motorically more complicated, were short ($M = 453$ ms) relative to judgment times ($M = 1158$ ms), as well as uninfluenced by the priming factors or neuroticism, $ps > .05$. Thus, the method was successful and the following analyses are specific to judgment times.

The reaction time distribution was skewed and we therefore performed RT-transformation procedures that are standard (Robinson, in press). First, we log-transformed the RT-data to normalize the distribution. Second, we replaced log-latencies 2.5 SDs below and above the grand latency mean with these cutoff values (2.29% of trials). These procedures are highly comparable to recommendations in the literature (e.g., Fazio, 1990), and seek to minimize the undue influence of outliers while including them (Robinson, in press). To the extent that a similar source of emotion knowledge is retrieved on two consecutive trials, the second

judgment should be primed or facilitated (McRae & Boisvert, 1998; Robinson, in press). We therefore coded both the valence of the target trial (i.e., trial n) and the valence of the emotion on the previous prime trial (i.e., trial $n - 1$). We then averaged ratings and judgment times separately for cells of the prime valence x target valence design.

We should note that positive words are typically more frequent than negative words (von Hippel, Forgas, Robinson, Shakarchi, & Hawkins, submitted). However, our hypotheses pertain to individual differences in affective priming rather than to speed to recognize positive versus negative targets. For present purposes, then, word frequencies would not be relevant.

Procedures

Participants completed the emotion judgment task on a personal computer in a private cubicle. Subsequently, they were administered the neuroticism scale. This procedural order follows evidence that implicit cognition is malleable, but we know of no evidence that trait scores are affected by performing affective judgment tasks (Robinson & Neighbors, 2006). Thus, the order of measures was designed to preclude trait-priming effects on implicit cognition.

Results

Neuroticism and Affective Priming

We hypothesized that neuroticism would predict affective priming for negative targets, but not positive ones. To examine such predictions, we performed two General Linear Model (GLM) analyses, one for each target valence. Prime Valence was a repeated measure, whereas Neuroticism was a continuous, z-scored variable (Robinson, in press). In the analysis involving positive targets, there was a main effect for Prime Valence, $F(1, 53) = 15.00, p < .01$, such that judgments were faster following positive ($M = 1156$ ms) than negative ($M = 1220$ ms) primes. However, effects involving Neuroticism were not significant, $F_s < 1$. Also, neuroticism did not correlate with the magnitude of the positive priming effect, $r(55) = .05, p > .65$.

The second GLM model involved negative targets. Main effects for Neuroticism and Prime Valence were not significant, $F_s < 1$. However, as predicted, there was a Neuroticism x Prime Valence interaction, $F(1, 53) = 4.77, p < .05$. Individuals high (+1 SD) in neuroticism, relative to those low (−1 SD) in neuroticism, were somewhat slower to judge negative targets following positive primes (Low $N = 1138$ ms; High $N = 1177$ ms). By contrast, individuals high in neuroticism were faster to judge negative targets following negative primes (Low $N = 1197$ ms; High $N = 1144$ ms). In other words, only individuals high in neuroticism displayed evidence of a negative priming effect (of 33 ms facilitation). The correlation between neuroticism and the magnitude of the negative priming effect was $r(55) = .29, p < .05$.

Neuroticism and Emotion Ratings

As is common in the literature, neuroticism was correlated with ratings indicating more intense negative emotions, $r(55) = .52, p < .01$, but did not predict ratings for positive emotions, $r(55) = -.16, p > .25$. We then computed rating-related priming effects in a similar manner to the latency data. Neuroticism did not predict rating-related priming effects for negative or positive targets, $p_s > .45$. Thus, the neuroticism-linked priming effects of Study 1 were particular to judgment times and cannot be explained by ratings in the task.

Discussion

Normatively, positive priming effects were quite a bit stronger than negative priming effects and we have observed this pattern before (e.g., Robinson & von Hippel, in press). Thus, irrespective of personality factors, it may be that positive affective knowledge is more

interconnected than negative affective knowledge and this fits with relevant theory and data (e.g., Fredrickson, 2001). Nevertheless, neuroticism predicted the extent to which encoding a negative stimulus sped encoding for a subsequent negative stimulus and only individuals high in neuroticism displayed this pattern. Thus, normative effects should be distinguished from those involving individual differences, a point that will be discussed more fully following Study 2.

Study 2

The purpose of Study 2 was to replicate and extend Study 1. In terms of replication, we again hypothesized that neuroticism would predict negative priming effects, but not positive priming effects. In terms of extending the results of Study 1, we decided to focus on a very different cognitive paradigm in Study 2. Rather than using a self-relevant judgment task, we used one that was not self-relevant as it merely involved the recognition of words. Rather than focusing on categorization processes, we focused on perceptual processes.

More specifically, Study 2 used a perceptual identification task. Perceptual identification tasks were used in the initial New Look movement, which posited that motivation and emotion influence perception (Dixon, 1981). More recently, perceptual identification tasks have been used to study the manner in which mood disorders (Williams, Watts, MacLeod, & Mathews, 1997) and affective priming (De Houwer, Hermans, & Spruyt, 2001) influence perceptual identification processes. Therefore, although the present predictions are novel, there is nevertheless some precedent for thinking that affective factors may systematically influence perceptual identifications.

Method

Participants

Participants were 90 (50 female) undergraduates from the University of Illinois, Champaign-Urbana.

Measures

Neuroticism—Neuroticism was measured using the same Goldberg (1999) scale also used in Study 1 ($\alpha = .90$).

Perceptual Identification Task—Participants in Study 2 were asked to quickly and accurately recognize words as they appeared on the computer screen. The task used 20 positive words (*ambition, celebrate, friendship, fun, gifts, happiness, joy, laughter, love, party, pleasure, praise, prize, reward, romance, success, treasure, triumph, victory, & wealth*) and 20 negative words (*conflict, criticism, danger, deadly, enemy, fatal, fear, harm, hazard, injury, insult, knife, menace, pain, panic, punishment, ridicule, threat, trouble, & weapon*), chosen from prior affect norms (Bradley & Lang, 1999).

Words were presented one at a time in a thick 24-point lower-case font. The words were presented in white color against a gray background. To degrade the stimuli, each trial began with a superimposed mask of 100% black pixels. Thus, at the time of the initial word presentation, the word could not be seen at all. Black pixels were removed at the rate of 25% per second. Hence, there was 50% superimposed noise at 2 seconds and 0% superimposed noise at 4 seconds. We expected that participants would be able to identify words somewhere in the 2–3 second range.

Each trial involved a randomly selected positive or negative word. Participants were instructed to accurately and quickly identify the word, at which point they should respond by pressing

the spacebar. Pressing the spacebar removed the stimulus from the screen and replaced it with a text box asking participants to type in the word. By these procedures, we could insure that the word had been identified, but that judgment latencies always reflected the same response (i.e., a spacebar press). After typing in the word, participants pressed the return key, and there was a 300 ms blank screen until the next (target) word was presented.

Accuracy of typed responses was high (M accuracy = 97.83%). We deleted trials associated with inaccurate responses and then examined the subsequent distribution of judgment times. Due to the perceptual degradation procedures, which precluded quick responding, the judgment time distribution closely approximated a normal distribution. For this reason, there was no need to log-transform the judgment times or replace outliers.

Because stimuli were randomly selected for each trial, positive or negative target (i.e., trial n) words were equally likely to follow positive or negative prime (i.e., trial $n - 1$) words. In order to examine priming effects, we computed accuracy and judgment time means separately for the four cells of the prime valence $\times$ target valence within-subject design.

Procedures

Assessment procedures were similar to Study 1. The perceptual identification task was administered first. After this task, participants were asked to report on their levels of trait neuroticism.

Results

Neuroticism and Affective Priming

As in Study 1, we performed two GLM analyses examining positive and negative target latencies as a function of Neuroticism and Prime Valence. In the analysis involving positive targets, none of the factors was a significant predictor, $F_s < 1$. This is not uncommon as normative affective priming effects are much more robust in tasks requiring evaluative judgments than in more perceptual tasks (Klauer & Musch, 2003). The correlation between neuroticism and the magnitude of the positive priming effect was $r(90) = -0.04$, $p > .70$.

In the GLM for negative targets, main effects for Neuroticism, $F < 1$, and Prime Valence (1, 88) = 2.16, $p > .10$, were not significant. However, there was a significant Neuroticism $\times$ Prime Valence interaction, $F(1, 88) = 8.09$, $p < .01$. Following positive primes, judgment times were somewhat very similar for those low ($-1 SD$: $M = 2125$ ms) and high ($+1 SD$: $M = 2133$ ms) in neuroticism. Following negative primes, by contrast, judgment times were faster at high ($M = 2115$ ms) relative to low ($M = 2180$ ms) levels of neuroticism. In other words, it was again true that only individuals high in neuroticism displayed evidence of a negative affective priming effect, here of 18 ms facilitation. The correlation between neuroticism and the magnitude of the negative priming effect was $r(90) = .29$, $p < .01$. Thus, Study 2 replicates Study 1 with respect to relations between neuroticism and the magnitude of the negative priming effect.

Neuroticism and Accuracy Rates

Neuroticism did not correlate with accuracy rates for identifying positive targets, $r(90) = .13$, $p > .20$, or negative targets, $r(90) = .06$, $p > .60$. Also, neuroticism did not correlate with accuracy-related priming effects in relation to positive targets, $r(90) = 0.00$, $p > .95$, or negative targets, $r(90) = -.14$, $p > .15$. Thus, the relation between neuroticism and negative affective priming was not compromised by a speed-accuracy tradeoff.

Discussion

The perceptual identification task used in Study 2 was quite different from the emotion judgment task of Study 1 in that perceptual identifications did not require the retrieval of self-knowledge or the categorization of affective stimuli. Rather, all that was required was the mere identification of words. These differences in task requirements account for different normative priming effects in the two studies, as affective priming effects in perceptual tasks tends to be small if they are observed at all (Klauer & Musch, 2003). Regardless, tasks of this type are important to the literature because they systematically remove requirements to evaluate primes and targets, and may thus be more sensitive to spreading activation processes (Fazio, 2001).

From this perspective, it was striking that normative priming effects were non-significant, but neuroticism still predicted the magnitude of the negative target priming effect. This dissociation between normative effects and individual difference correlates is not unique to the present study. In brain-imaging studies, it has repeatedly been found that the two levels of analysis often result in different conclusions. For example, happy faces (versus neutral ones) do not activate the amygdala in normative analyses (Canli, 2004). Regardless, extraversion correlates with the extent to which happy faces activate the amygdala (Canli, 2004). This sort of pattern has been repeatedly observed and suggests that the two levels of analyses deserve separate statistical and theoretical treatment. Thus, although the 18 ms facilitation effect observed at high levels of neuroticism would not be significant on its own terms, the results nonetheless indicate that neuroticism predicts the magnitude and direction of negative affective priming, even in relatively perceptual tasks associated with no normative priming effects.

General Discussion

The studies began with the general premise that neuroticism may systematically relate to the inter-connectivity of negative affect within semantic memory networks. To investigate this prediction, we conducted two studies that allowed us to examine the extent to which encoding a first negative stimulus sped the encoding of a second negative stimulus. Although neuroticism did not correlate with faster judgments (Study 1) or perceptual identifications (Study 2) of negative affective targets, it did predict the magnitude of negative priming effects in two very different cognitive tasks. Specifically, individuals high in neuroticism displayed stronger negative priming effects in both tasks.

Although the recent affective priming literature does not tend to distinguish affective priming effects for positive and negative targets, it appears useful to do so (Robinson, in press; Robinson & Compton, in press). This distinction was especially useful here in that we found that neuroticism predicted priming effects for negative but not positive targets. Also, although normative priming effects were very different in the two studies, the individual difference correlates of affective priming were quite robust across the two tasks. This suggests that affective priming tasks may be sensitive to individual differences in affective memory networks even in the absence of normative priming effects.

Perhaps more important are conclusions related to trait neuroticism. This trait has been linked to a wide variety of negative outcome variables such as negative affect, worry, and somatic symptoms (Watson, 2000). These robust correlations suggest that neuroticism may be especially important in predicting cognitive-affective tendencies related to negative affective stimuli. Yet, evidence for such robust correlations is modest (Matthews & Gilliland, 1999; Robinson, in press; Rusting, 1998). Such modest correlations suggest the needs for further refinement of the cognitive-affective model of neuroticism.

The present studies add important data along these lines, and do so by contrasting target accessibility effects with prime-target spreading activation processes. Target accessibility

effects are those related to “target” stimuli and the general idea is that neuroticism may speed recognition of, or judgments concerning, negative affective targets. Yet, there was no evidence along these lines in the present studies (nor in other studies that have examined it, such as those of Robinson, Meier, & Vargas, 2005, or Tamir & Robinson, 2004). However, neuroticism predicted the extent to which one negative affect stimulus primed another one in semantic memory.

The latter effect may provide an understanding of other neuroticism-linked processes. Specifically, a greater spread of activation among negative thoughts might help to explain why individuals higher in neuroticism are more reactive to negative events (Gross et al., 1998) and ruminate on them to a greater extent (Muris et al., 2005). In both cases, it seems likely that negative events may be more consequential at high levels of neuroticism because they prime other negative thoughts within semantic memory. In sum, semantic memory networks favoring negative affect may help understand some of the negative affective biases linked to trait neuroticism (Rusting, 1998).

With respect to the external validity of the present findings, we can point out that millisecond differences in reaction time predict important life outcomes related to subjective well-being (e.g., Robinson & Compton, in press). We can also point out that affective priming effects predict trait and daily levels of life satisfaction, such that higher levels of life satisfaction are observed among those with stronger positive priming effects relative to negative priming effects (Robinson & Kirkeby, 2005; Robinson & von Hippel, in press). Thus, individual differences in affective processing have functional consequences (Canli, 2004), including those related to everyday experiences of emotion (Robinson & Compton, in press). We are hopeful that future work can extend this idea with reference to neuroticism and negative affective priming.

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